

Appl. No. 10/774,549
Amtd. Dated February 10, 2006
Reply to Office Action of October 11, 2005

Attorney Docket No. 81716.0119
Customer No.: 26021

REMARKS/ARGUMENTS:

Claims 2 and 8 are amended. New claim 16 is added. Claims 2, 5, 6, 8, and 16 are pending in the application. Reexamination and reconsideration of the application, as amended, are respectfully requested.

The present invention relates to a ceramic circuit board which is constructed by a ceramic substrate and metal circuit plates attached to both surfaces of the ceramic substrate. The invention also relates to a ceramic circuit board which is constructed by a ceramic substrate, metal circuit plates attached to both surfaces of the ceramic substrate, and a metal column arranged within the ceramic substrate to connect the two metal circuit plates, and to a method for manufacturing said ceramic circuit board. (Applicant's specification, at p. 1, lines 5-13).

CLAIM REJECTIONS UNDER 35 U.S.C. § 103:

Claims 2, 5, 6, and 8 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Makoto et al. (Japanese Patent No. JP406120634A). The Applicant respectfully traverses this rejection. Claim 2, as amended, is as follows:

A method for manufacturing a ceramic circuit board, comprising the steps of:

preparing a ceramic substrate having a through hole, a metal column with brazing material, and at least two pieces of metal circuit plates, said metal column with brazing material being made longer relative to a thickness of the ceramic substrate, by coating both ends of a metal column which is shorter relative to the thickness of the ceramic substrate, with a brazing material;

arranging the metal column with brazing material within the through hole of the ceramic substrate, so that a cavity is defined along

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the entire length of the metal column, between an inner wall surface of the through hole and an outer wall surface of the metal column, and arranging the metal circuit plates on both surfaces of the ceramic substrate in such a way as to stop up the through hole; and

bonding, after melting the brazing material by heating, the metal column and the metal circuit plates together via the molten brazing material.

Applicant respectfully submits that Makoto cannot render amended claim 2 obvious. Claim 2 was amended to clarify that the present invention requires a space between an inner wall surface of the through hole and an outer wall surface of the metal column that defines a cavity along the entire length of the metal column. The space that defines a cavity in present claim 2 offers the advantage that thermal expansion between the ceramic substrate and the metal column is accommodated. (Applicant's specification, at p. 24, lines 20-22). "Thus, even if, when heat is applied to the ceramic circuit board, the outer wall surface of the metal column is expanded and swollen due to the difference in the thermal expansion coefficient between the ceramic substrate and the metal column, the resultant expansion can be successfully accommodated by the space. This helps prevent the inner wall surface of the through hole from being pressed and expanded by the outer wall surface of the metal column, and thereby prevent occurrence of crack or fracture in the ceramic substrate. As a result, the ceramic circuit board can be operated normally and stably for a longer period of time." (Applicant's specification, at p. 12, lines 14-23).

In Makoto, a space is also formed between an inner wall surface of a through hole and an outer wall surface of a pin. However, in Makoto, the melted brazing material enters the space and is filled with a solidified brazing material, as shown

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in Figures 1(E) and 3(B) of Makoto. In Makoto, "the through hole 12 is filled with solidified brazing metal 18 thus ensuring conduction between the aluminum plates 14, 15 on the surface and the rear." (Makoto, Abstract- English translation, at p. 2, lines 13-17). On the other hand, in the present invention, the space is not filled with the brazing material. When the space is filled with the brazing material, it is difficult for the space to securely accommodate the expansion of the inner wall surface of the through hole of the substrate, which is caused by the outer wall surface of the metal column swollen. Makoto does not consider this point. In the present invention, the brazing material (items 2 and 6 of Figure 1) is restricted to the upper and lower surfaces of the ceramic substrate and the ends of the metal column. (Applicant's specification, at p. 16, lines 13-19). Hence, the space between the metal column and the ceramic substrate defines a cavity, and the benefits discussed above are achieved.

Makoto discloses a through hole structure for a high-power ceramic substrate and a simplified manufacturing method for the high-power ceramic substrate. Makoto teaches that it is not necessary to fill the whole space of a through hole with brazing metal poured into the through hole. Makoto further teaches that when the through hole is sealed with a brazing metal, it is natural that gas bubbles or the like result from entrapment of air present in the through hole (Makoto, paragraphs [0023] and [0027], Figure 3B).

Makoto fails to teach or suggest a cavity along the entire length of the metal column, wherein such cavity offers the advantageous effect of the present invention which is that a thermal expansion between the ceramic substrate and the metal column is accommodated.

In light of the foregoing, Applicant respectfully submits that Makoto could not have rendered amended claim 2 obvious, because Makoto does not teach or

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suggest each and every claim limitation. Claims 5, 6, and 8 depend from claim 2 and cannot be made obvious for at least the same reasons as claim 2. Withdrawal of these rejections is thus respectfully requested.

New claim 16 depends from claim 2 and cannot be made obvious for at least the same reasons as claim 2.

The art made of record but not relied upon by the Examiner has been considered. However, it is submitted that this art neither describes nor suggests the presently claimed invention.

In view of the foregoing, it is respectfully submitted that the application is in condition for allowance. Reexamination and reconsideration of the application, as amended, are requested.

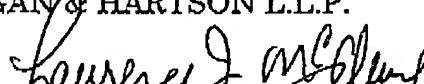
If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles, California telephone number (213) 337-6810 to discuss the steps necessary for placing the application in condition for allowance.

If there are any fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-1314.

Respectfully submitted,

HOGAN & HARTSON L.L.P.

Date: February 10, 2006

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